DOCUMENT RESUME

ED 462 259 SE 060 566

TITLE	Biology 30: Grade 12 Diploma Examination, June 1997.
INSTITUTION	Alberta Dept. of Education, Edmonton. Student Evaluation Branch.
PUB DATE	1997-06-00
NOTE	51p.
AVAILABLE FROM	Alberta Education, Student Evaluation Branch, 11160 Jasper Avenue, Edmonton, Alberta T5K 0L2, Canada.
PUB TYPE	Tests/Questionnaires (160)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	*Biology; Foreign Countries; *Grade 12; High Schools; *Science Tests; Scientific Concepts
IDENTIFIERS	*Alberta Grade Twelve Diploma Examinations

ABSTRACT

This document is a Biology 30 Grade 12 Diploma Examination from Alberta Education. It is a 2.5 hour closed-book examination consisting of 48 multiple-choice and eight numerical-response questions of equal value worth 70% of the examination and two written-response questions of equal value worth 30% of the examination. The exam contains sets of related questions that may contain multiple-choice and/or numerical-response and/or written response questions. The exam booklet also contains tear-out data pages and blank perforated pages for rough work. (JRH)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 462 259

June 1997

Biology 30

Grade 12 Diploma Examination

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY
C. Andrews
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Alberta EDUCATION

BEST COPY AVAILABLE

Copyright 1997, the Crown in Right of Alberta, as represented by the Minister of Education, Alberta Education, Student Evaluation Branch, 11160 Jasper Avenue, Edmonton, Alberta T5K 0L2. All rights reserved. Additional copies may be purchased from the Learning Resources Distributing Centre.

Special permission is granted to **Alberta educators only** to reproduce, **for educational purposes and on a non-profit basis**, parts of this examination that do **not** contain excerpted material **only after the administration of this examination**.

Excerpted material in this examination **shall not** be reproduced without the written permission of the original publisher (see credits page, where applicable).

June 1997

Biology 30

Grade 12 Diploma Examination

Description

Time: 2.5 h. You may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 48 multiple-choice and 8 numerical-response questions, of equal value, worth 70% of the examination
- 2 written-response questions, of equal value, worth 30% of the examination
- 80 total possible marks, worth 100% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

Tear-out data pages are included near the back of this booklet.

The blank perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.

Instructions

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- You are expected to provide your own scientific calculator.
- Use only an HB pencil for the machine-scored answer sheet.
- If you wish to change an answer, erase **all** traces of your first answer.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. biology
B. physics
C. chemistry
D. science

Answer Sheet

● Ⓑ Ⓒ Ⓓ

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

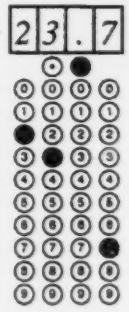
Examples

Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _____.
(Round and record your answer to three significant digits in the numerical-response section of the answer sheet.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666
= 23.7

Record 23.7 on the answer sheet →



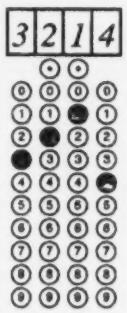
Correct-Order Question and Solution

When the following subjects are arranged in alphabetical order, the order is _____.
(Record all four digits in the numerical-response section of the answer sheet.)

1 physics
2 chemistry
3 biology
4 science

Answer 3214

Record 3214 on the answer sheet →



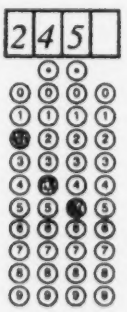
Selection Question and Solution

The birds in the following list are numbered _____.
(Record your answer in lowest-to-highest numerical order in the numerical-response section of the answer sheet.)

1 dog
2 sparrow
3 cat
4 robin
5 chicken

Answer 245

Record 245 on the answer sheet →

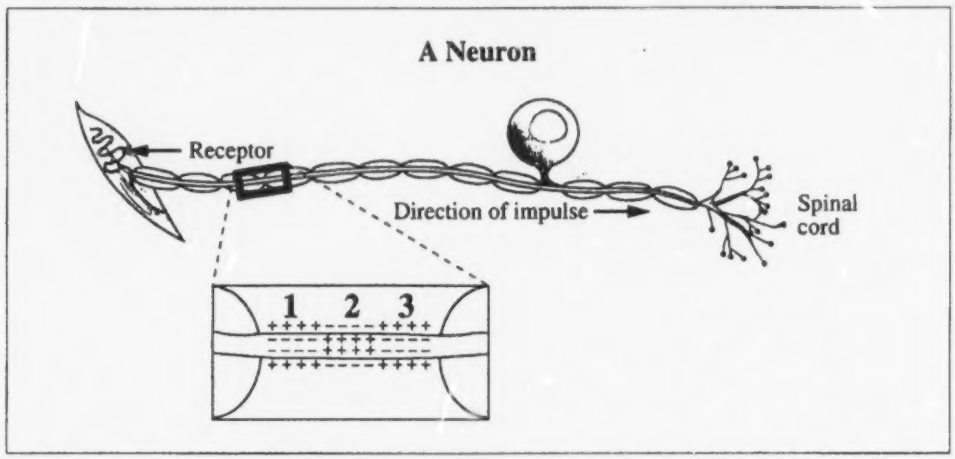


Written Response

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must be well organized and address **all** the main points of the question.
- Relevant scientific, technological, and/or societal concepts and examples must be identified and explicit.
- Descriptions and/or explanations of concepts must be correct and reflect pertinent ideas, calculations, and formulas.
- Your answers **should be** presented in a well-organized manner using complete sentences, correct units, and significant digits where appropriate.

Nervous and endocrine systems maintain internal equilibrium while humans interact with their external environment. The study of organisms and of disease processes has helped extend our knowledge of these systems.

Use the following information to answer the next two questions.



1. This neuron transmits an impulse from a receptor to the central nervous system; therefore, it is

   A. a motor neuron
   B. a sensory neuron
   C. an autonomic neuron
   D. an association neuron

Numerical Response

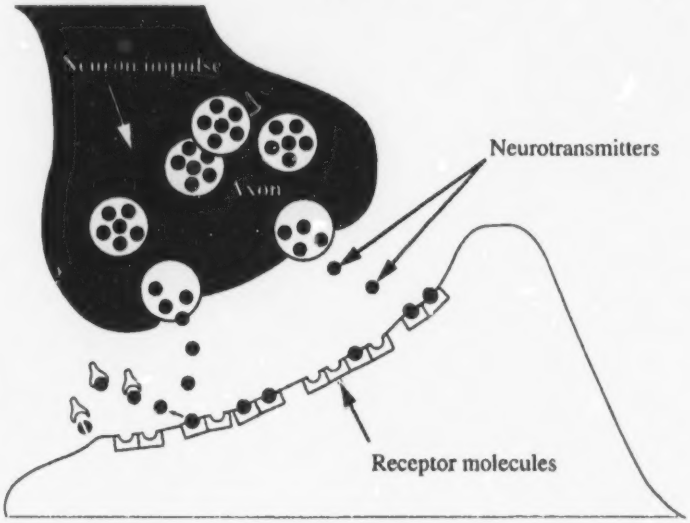
1. In the diagrammed neuron, which numbers represent segments of the axon that are, respectively, polarized, repolarized, and depolarized, during normal neural impulse conduction?

   (Record your **three-digit answer** in the numerical-response section of the answer sheet.)

   Answer: _____ _____ _____
   polarized repolarized depolarized

Use the following information to answer the next two questions.

A Synapse



1 Attachment of neurotransmitters to receptor molecules
2 Diffusion of neurotransmitters across the synapse
3 Destruction of the neurotransmitter by an enzyme
4 Exocytosis of the neurotransmitter

Numerical Response

2. Identify the sequence of events that would occur when a signal crosses the synapse.

(Record your **four-digit answer** in the numerical-response section of the answer sheet.)

Answer: _____

Use the additional information to answer the next question.

Serotonin is a neurotransmitter found in the brain. Some studies show that too little serotonin may cause depression and lead to a tendency to behave impulsively.
—from *The Edmonton Journal*

2. Excitatory neurotransmitters like serotonin

A. hyperpolarize a postsynaptic neural membrane
B. block the postsynaptic membrane's receptor sites
C. increase the permeability of postsynaptic membranes to sodium
D. decrease the permeability of postsynaptic membranes to sodium

Use the following diagram to answer the next question.

Inside the Human Ear

3. Which structure acts as a lever to mechanically amplify sound vibrations?

   A. Structure 1
   B. Structure 2
   C. Structure 3
   D. Structure 4

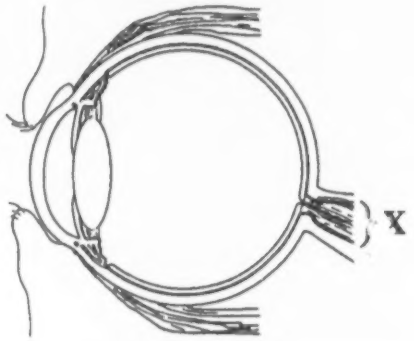
---

4. A person outside the gravitational field of Earth experiences disruption of normal functions of the inner ear. The region of the brain processing the disruption and the ability affected by this disruption are, respectively, the

   A. cerebellum and the ability to walk a straight line
   B. cerebrum and the ability to write legibly
   C. cerebellum and the ability to hear
   D. cerebrum and the ability to speak

Use the following information to answer the next question.

The Human Eye



5. For a person to experience sight, neural transmissions from structure **X** must reach which lobe of the cerebrum?

   A. The frontal lobe
   B. The parietal lobe
   C. The occipital lobe
   D. The temporal lobe

---

6. After having a stroke, a person finds that he cannot contract muscles in his right arm and that he suffers from speech impairment. The person probably has brain damage in the

   A. left side of the cerebrum
   B. right side of the cerebrum
   C. left side of the cerebellum
   D. right side of the cerebellum

Use the following information to answer the next two questions.

> Polygraphs (lie detectors) monitor some changes in some activities of the nervous system. In theory, an emotionally stressful situation like telling lies will increase perspiration, increase breathing and heart rates, and cause slight dilation of pupils. However, polygraphs cannot exclusively differentiate between telling lies and other stressful situations.

7. The physiological changes that are associated with telling lies are responses produced by impulses coming from

A. motor nerves of the somatic nervous system
B. sensory nerves of the somatic nervous system
C. sympathetic nerves of the autonomic nervous system
D. parasympathetic nerves of the autonomic nervous system

8. Emotionally stressful situations may affect more than one system of the body. Another possible response produced by telling lies would be

A. decreased secretion of ADH
B. increased secretion of insulin
C. decreased secretion of glucagon
D. increased secretion of epinephrine

Use the following information to answer the next two questions.

> On April 26, 1986, a major accident occurred at a nuclear generating station in Chernobyl. The nuclear explosion dispersed several tons of radioactive iodine, cesium, uranium, and other elements five kilometres into the air.
>
> Radioactivity is extremely damaging to living cells.
>
> —from *Biosphere 2000: Protecting Our Global Environment*

9. As soon as people in Europe realized there had been a nuclear accident, they rushed to buy iodine tablets. What reason would people have for consuming large quantities of iodine?

A. So that iodine from the tablets, instead of the radioactive iodine, would accumulate in the thyroid.

B. Because iodine, by negative feedback, blocks the formation of TSH, therefore protecting the thyroid from radioactivity.

C. Because iodine inhibits cell division, thereby reducing the amount of cellular damage occurring during exposure to radiation.

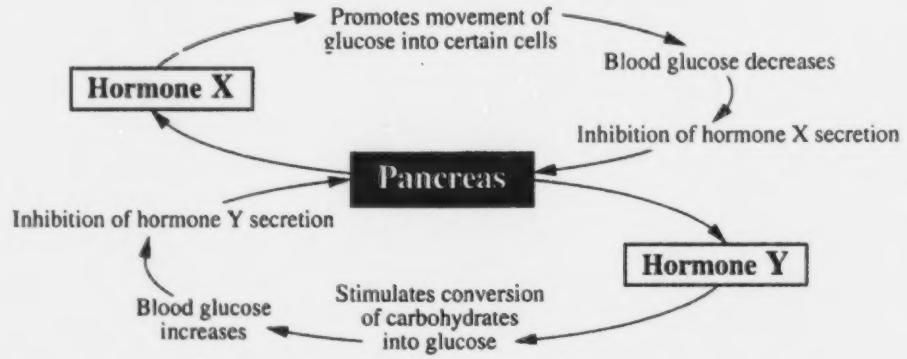
D. So that iodine could accumulate in the hypothalamus and block communication between the nervous and endocrine systems.

10. Which symptoms would be expected among people who did not take iodine tablets?

A. Pancreatic dysfunction and insufficient insulin production
B. Metabolic dysfunction resulting in fatigue and weight gain
C. Increased ACTH secretion and puffiness of face, chest, and abdomen
D. Pituitary dysfunction resulting in increased HGH secretion and thus giantism

Use the following diagram to answer the next question.

The Control of Blood Glucose Levels by the Pancreas

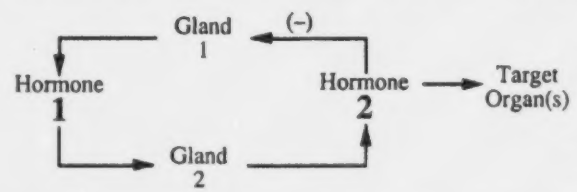


11. Hormones **X** and **Y**, respectively, are

A. insulin and glucagon
B. glucagon and insulin
C. insulin and epinephrine
D. epinephrine and insulin

Use the following information to answer the next question.

Control of the Secretion of Hormone 1 and Hormone 2

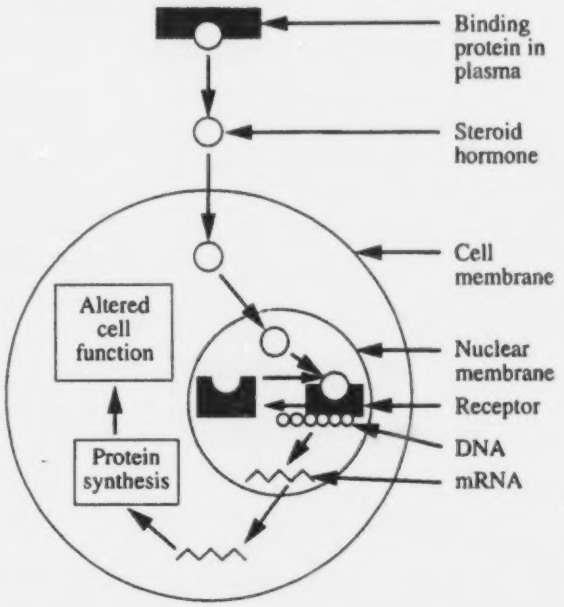


12. If Gland 1 is the pituitary gland, the row that identifies Hormone 1, Gland 2, and Hormone 2 is

Row	Hormone 1	Gland 2	Hormone 2
A.	FSH	testes	testosterone
B.	TSH	thyroid	thyroxine
C.	FSH	ovaries	progesterone
D.	ADH	kidney	aldosterone

Use the following information to answer the next question.

A steroid hormone secreted from a gland attaches to a binding protein and travels in the blood plasma to a target organ. The hormone is released from the binding protein, enters a target cell, and binds to a specific receptor molecule.



13. A steroid hormone likely alters cell function when a hormone-receptor complex

A. produces enzymes necessary for protein synthesis
B. enables DNA to leave the nucleus to synthesize proteins
C. translates mRNA required for protein synthesis in the nucleus
D. activates genes responsible for the synthesis of particular proteins

14

Reproductive processes may be affected by disease, the environment, or the use of technology.

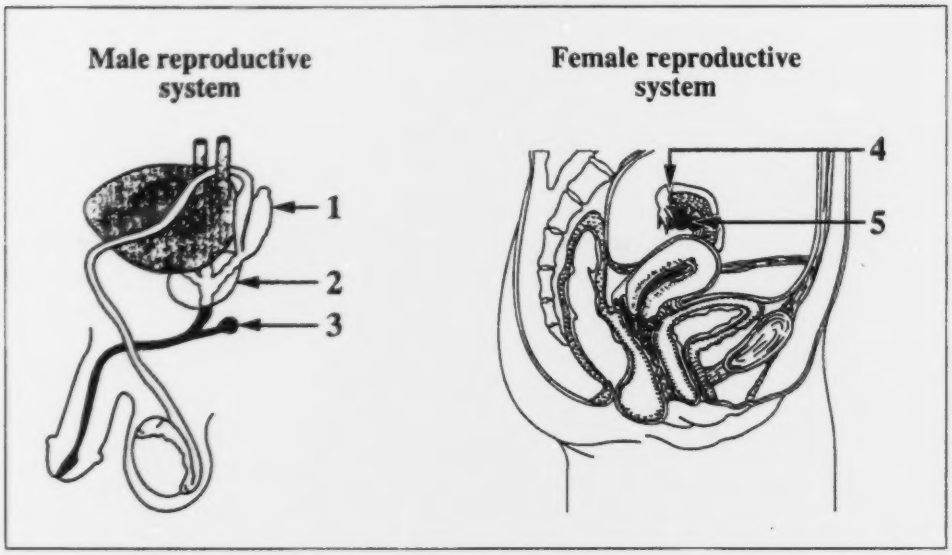
14. In females, the onset of puberty is initiated by secretions from the

A. follicle
B. endometrium
C. corpus luteum
D. hypothalamus

15. In males, a *Chlamydia* infection may cause inflammation in areas of the reproductive system. The maturation and storage of sperm might be directly affected if inflammation occurs in the

A. epididymis
B. vas deferens
C. prostate gland
D. seminal vesicles

Use the following information to answer the next two questions.



16. The collective function of structures **1**, **2**, and **3** is the production of components of

A. urine
B. sperm
C. semen
D. testosterone

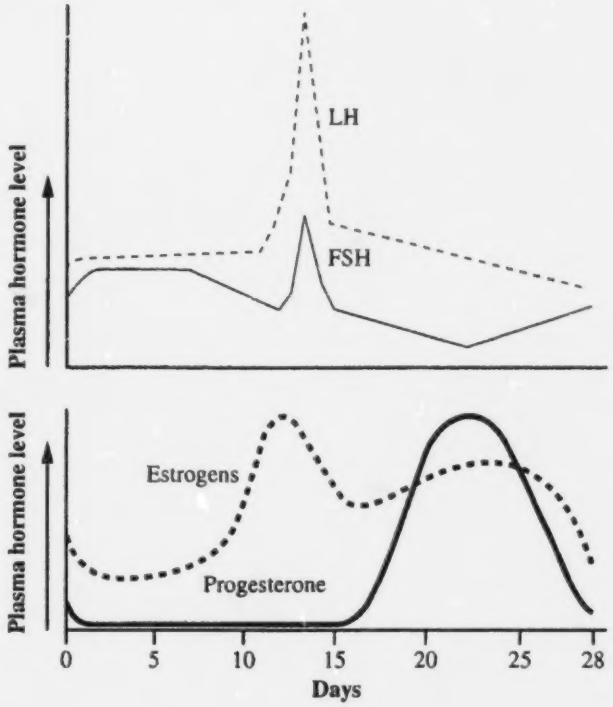
17. The row that identifies the structures in the male that have similar functions to structures 4 and 5 in the female is

Row	Structure 4	Structure 5
A.	vas deferens	testes
B.	vas deferens	prostate gland
C.	seminiferous tubules	testes
D.	seminiferous tubules	prostate gland

16

Use the following information to answer the next question.

Changing Levels of Hormones During the Menstrual Cycle



18. Which hormone is at its lowest level at the time of ovulation?

A. LH
B. FSH
C. Estrogen
D. Progesterone

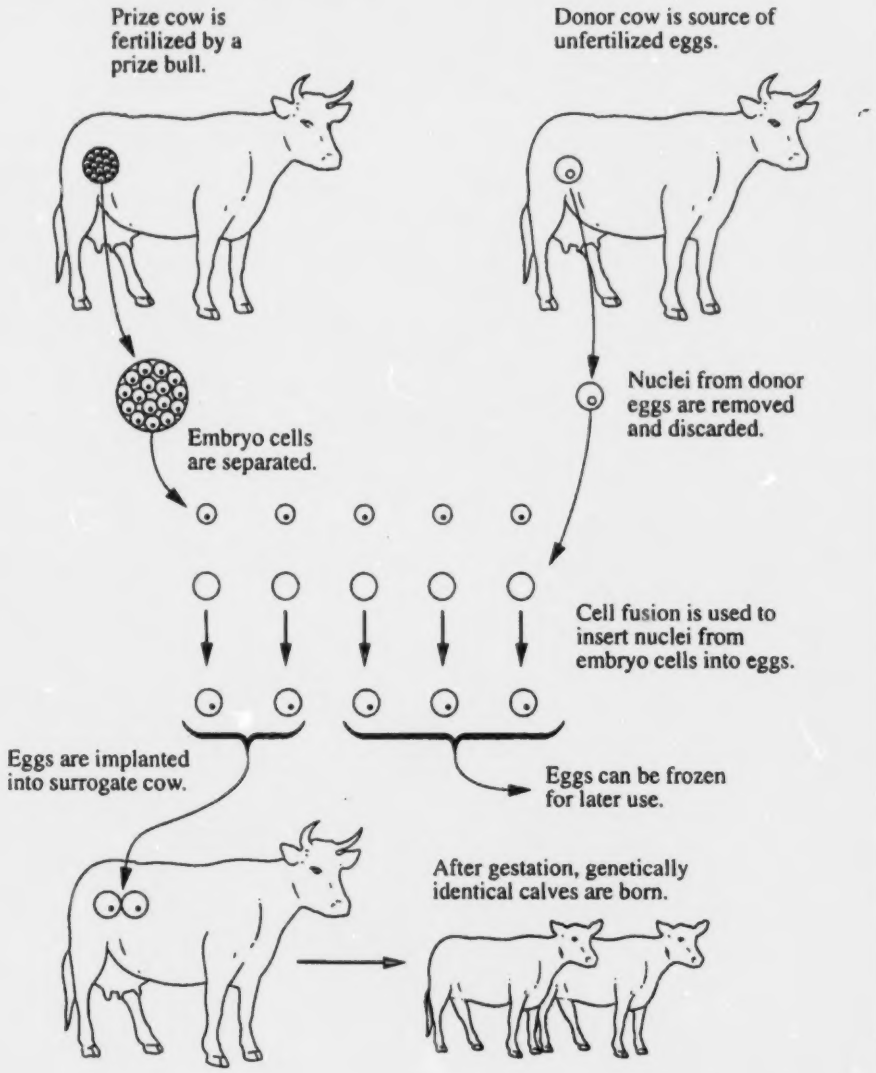
---

19. A thick and vascularized endometrium

A. remains when progesterone levels and estrogen levels both decrease
B. is present when an egg is fertilized and progesterone levels decrease
C. is present when an egg is fertilized and progesterone levels remain high
D. remains when progesterone levels decrease and estrogen levels remain high

Use the following information to answer the next two questions.

One type of livestock cloning involves the removal and separation of cells from a growing calf embryo. Unfertilized egg cells are taken from surrogate cows and the nucleus from each egg cell is removed. A nucleus from each of the embryo cells is then injected into an unfertilized, enucleated egg cell and implanted into the surrogate cow. In theory, the implanted structures will develop into calves identical to each other.


Prize cow is fertilized by a prize bull.
Donor cow is source of unfertilized eggs.
Nuclei from donor eggs are removed and discarded.
Embryo cells are separated.
Cell fusion is used to insert nuclei from embryo cells into eggs.
Eggs are implanted into surrogate cow.
Eggs can be frozen for later use.
After gestation, genetically identical calves are born.

—from *Human Heredity*

20. During their development into calf fetuses, the clones undergo repeated cycles of

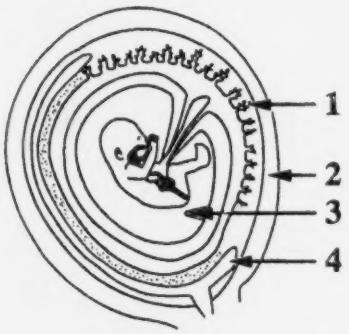
A. mitosis
B. meiosis
C. both mitosis and meiosis
D. neither mitosis nor meiosis

21. In the surrogate cow, implantation would occur in the

A. ovary
B. uterus
C. cervix
D. Fallopian tube

Use the following information to answer the next question.

A Developing Fetus and Associated Structures



22. During labour, smooth muscle contractions occur in structure

A. 1
B. 2
C. 3
D. 4

---

23. Milk production and the release of milk, respectively, are stimulated by the hormones

A. estrogen and oxytocin
B. prolactin and oxytocin
C. estrogen and progesterone
D. prolactin and progesterone

20

Use the following information to answer the next question.

Processes in Human Reproduction

1 ovulation
2 parturition
3 fertilization
4 implantation

Numerical Response

3 Identify the sequence of the processes in human reproduction.

(Record your **four-digit answer** in the numerical-response section of the answer sheet.)

Answer: _____

Use the following information to answer the next question.

Hall and Stillman, *in vitro* fertilization specialists in Washington, D.C., recently announced that they successfully took a two-cell stage human embryo and separated the two cells. These separated cells grew independently of each other for five successive divisions before cell division spontaneously stopped.

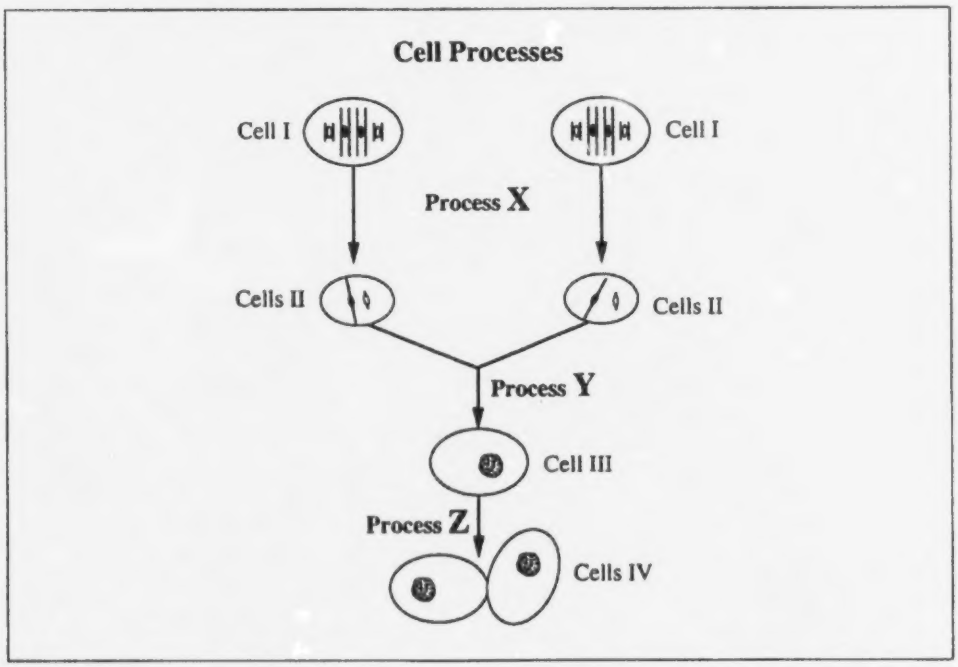
—from *Discover*

24. If each of the two cell masses produced had developed into a normal fetus, the fetuses would have been

A. identical twins and of the same sex
B. fraternal twins and of the same sex
C. fraternal twins and of different sexes
D. identical twins and of different sexes

The study of cell division, chromosome composition, and the structure and function of DNA increases understanding of growth, genetic continuity, and diversity of organisms.

Use the following information to answer the next two questions.



25. What does process **Y** represent?

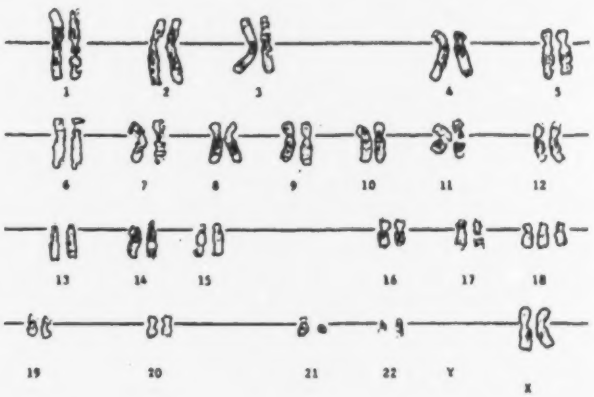
A. Oogenesis
B. Fertilization
C. Gastrulation
D. Spermatogenesis

26. The cell processes diagrammed are more advantageous than budding because

A. new genetic combinations are produced
B. recessive gene combinations cannot occur
C. less variation occurs increasing survival rates
D. only successful genetic combinations are produced

Use the following information to answer the next two questions.

To prepare a karyotype, cells are broken open and the chromosomes are stained with a dye. A photograph of the chromosomes is taken, and the chromosomes are arranged in pairs. Below is an example of a human karyotype that provides information about an individual.



—from *Human Heredity*

27. According to this karyotype, this individual has

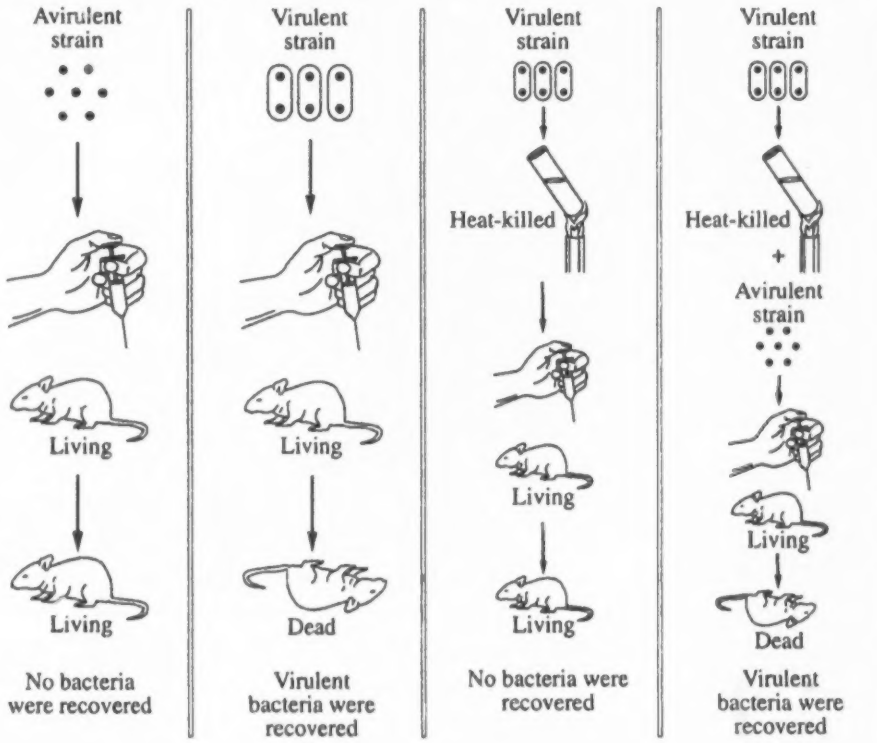
A. one less autosome than normal
B. one more autosome than normal
C. one less sex chromosome than normal
D. one more sex chromosome than normal

28. This unusual number of chromosomes is the result of

A. synapsis during gametogenesis
B. crossing over during gametogenesis
C. nondisjunction during gametogenesis
D. lack of cytokinesis during gametogenesis

Use the following information to answer the next question.

In 1928, a British scientist, Frederick Griffith, performed an experiment by injecting mice with two strains of bacteria. The avirulent bacteria strain did not cause pneumonia, and the virulent bacteria strain caused pneumonia. Below is an illustration of his results.



—from *Biology Directions*

29. The results illustrated can be **best** interpreted as showing that

A. the genetic material was deoxyribonucleic acid

B. some of the virulent bacteria had survived heat treatment

C. genetic material from the dead virulent bacteria had entered the living avirulent bacteria

D. genetic material from the avirulent strain caused the change to the virulent bacteria

Use the following information to answer the next two questions.

The tables below represent a portion of a DNA molecule and its corresponding mRNA, tRNA, and polypeptide chain.

DNA:	C	G	T									
	G	C	A				T	G	A			
mRNA:			U	U			A				**Y**	
tRNA:							**X**			G	C	A

Amino acids:	**W**	Tryptophan		

30. The nitrogen bases for positions **X** and **Y** are, respectively,

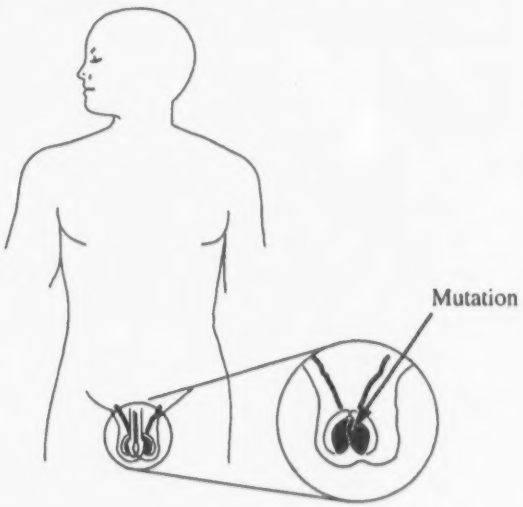
A. uracil and guanine
B. uracil and cytosine
C. adenine and cytosine
D. thymine and guanine

31. The amino acid labelled **W** is

A. methionine
B. tryptophan
C. arginine
D. alanine

Use the following information to answer the next two questions.

Mutations occur in all organisms spontaneously. The natural rate of change is normally very low, but this rate can be increased by environmental factors such as ionizing radiation (e.g., ultraviolet light and X-rays) and mutagenic chemicals (e.g., benzene).



32. Which process would allow a mutation in the location shown to be passed on to the next generation?

A. Mitosis
B. Oogenesis
C. Nondisjunction
D. Spermatogenesis

33. By causing physical damage to a cellular component, ionizing radiation or chemicals can cause mutations. The site of this damage is

A. the nuclear membrane
B. the protein structure of the ribosome
C. one or more amino acids in a crucial enzyme
D. one or more nucleotides in the DNA molecule

Use the following information to answer the next question.

> A bacterium has been found that synthesizes a type of plastic called polyhydroxybutyrate (PHB). Researchers can remove genes from this bacterium, "cut" open the DNA in plant cells, and insert the bacterial genes. Plants grown from these transformed cells will synthesize PHB.
>
> —from *Science News*

34. The row that identifies the enzymes likely used by researchers to move the genes from the bacterium to a plant is

Row	Enzyme(s) Used on Bacterial DNA	Enzyme(s) Used on Plant DNA
A.	Ligase only	Ligase and restriction
B.	Restriction only	Ligase only
C.	Restriction only	Restriction and ligase
D.	Restriction and ligase	Restriction only

Use the following information to answer the next question.

A Human Cell

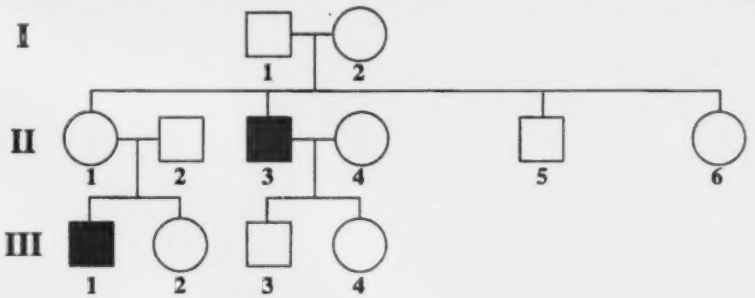
35. Which structures in the diagrammed human cell contain DNA?

A. Structures 1 and 3
B. Structures 1 and 4
C. Structures 2 and 3
D. Structures 3 and 5

Use the following information to answer the next three questions.

Hypohidrotic ectodermal dysplasia is a rare genetic disease that causes problems with most **embryonic ectoderm development**, but does not usually affect the nervous system. Individuals are born apparently healthy but lack sweat glands.

A Pedigree for a Family Affected by Hypohidrotic Ectodermal Dysplasia



Note: Carriers have not been identified and all marriage partners are known to be unrelated.

—from *Discover*

36. The inheritance pattern of this disease is **most likely**

A. X-linked recessive
B. X-linked dominant
C. autosomal recessive
D. autosomal dominant

37. Which structure or organ would **not** develop properly in a person with hypohidrotic ectodermal dysplasia?

A. Muscle
B. Heart
C. Liver
D. Skin

38. Which individuals from the pedigree are **definitely** carriers of the disease?

A. I-1 and II-5
B. I-2 and II-1
C. III-1 and III-4
D. III-2 and III-4

Use the following information to answer the next two questions.

In Alaskan Malamute dogs, a recessive allele causes a condition in which the cartilage in the front legs fails to develop properly. This results in a type of dwarfism. Dogs with the dominant wild-type allele are of normal height.

In the same breed of dogs, there is a dominant allele that codes for a curled tail and a recessive allele that codes for an uncurled tail.

Legend:

H – normal height
h – dwarfism
C – curled tail
c – uncurled tail

Dwarf Malamute with curled tail

Malamute of normal height with uncurled tail

39. The row that correctly shows the expected ratio of offspring phenotypes of a cross between two dogs heterozygous for height and tail curl is

Row	Normal Height Curled Tail	Normal Height Uncurled Tail	Dwarf Curled Tail	Dwarf Uncurled Tail
A.	0	1	1	0
B.	1	1	1	1
C.	1	3	3	9
D.	9	3	3	1

40. If a dog that is heterozygous for height and tail curl is crossed with a dog that is recessive for both traits, the four possible genotypes for the offspring are

A. HhCc, Hhcc, hhCc, hhcc
B. HhCc, HhCC, hhCc, hhcc
C. HhCc, Hhcc, hhCC, hhcc
D. HhCc, HHCc, hhCc, hhcc

Use the following information to answer the next four questions.

Feather colour for Andalusian fowl is governed by incomplete dominance of a pair of alleles. Fowl may have black, white, or blue feathers. Blue-feathered birds are heterozygotes. In a randomly mating population of 400 fowl, there were 49 white-feathered birds.

41. The allele frequencies p (black) and q (white), respectively, are

A. $p = 0.3$ and $q = 0.7$
B. $p = 0.7$ and $q = 0.3$
C. $p = 0.35$ and $q = 0.65$
D. $p = 0.65$ and $q = 0.35$

Numerical Response

4. What is the frequency of the heterozygous genotype in this population of Andalusian fowl?

(Record your **answer as a value from 0 to 1, rounded to two decimal places,** in the numerical-response section of the answer sheet.)

Answer: _____

42. When a black-feathered hen is mated with a white-feathered rooster, what feather colour will the offspring have?

A. All will have blue feathers.
B. All will have black feathers.
C. Some will have black and some will have white feathers.
D. Some will have black, some will have white, and some will have blue feathers.

Numerical Response

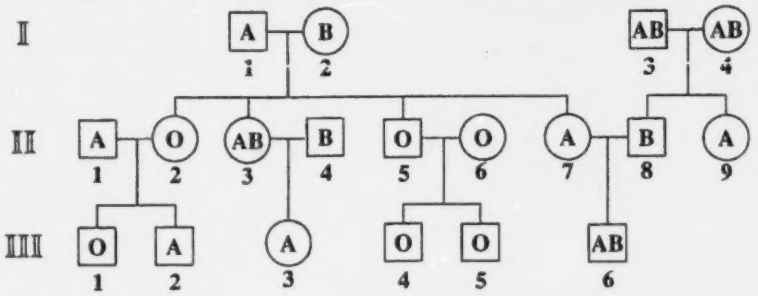
5. In a cross between a blue-feathered rooster and a white-feathered hen, what percentage of the offspring are expected to be white-feathered?

(Record your **answer as a whole number percentage** in the numerical-response section of the answer sheet.)

Answer: _____%

Use the following information to answer the next question.

A Pedigree Showing the ABO Blood Types of a Family



43. How many people in **Generation III** are homozygous for blood type?

A. 1
B. 2
C. 3
D. 4

Use the following information to answer the next question.

The characteristics plexus wings, scabrous eyes, speckled body, and brown eyes are influenced by genes found on chromosome 2 of the common fruit fly, *Drosophila melanogaster.*

Crossover frequencies between the genes are given in the following table.

Characteristic (Identification number)	Crossover frequency
Speckled body (3) and scabrous eyes (2)	41%
Brown eyes (4) and plexus wings (1)	4%
Plexus wings (1) and scabrous eyes (2)	34%
Speckled body (3) and brown eyes (4)	3%

—from *An Introduction to Genetic Analysis*

Numerical Response

6. Predict the order in which the genes occur on chromosome 2. Use the numbers following the characteristics to code your answer.

(Record your **four-digit answer** in the numerical-response section of the answer sheet.)

(There are two possible ways of recording the answer; either will be acceptable.)

Answer: _____

Communities are made of populations and may reach equilibrium or change over time.

Use the following information to answer the next four questions.

A population of rattlesnakes contained 1 000 individuals at the beginning of a year. During the year, the population changed in the following ways:

births	106
deaths	53
immigration	42
emigration	15

The population occupied an area of 160 hectares.

Numerical Response

7. Calculate the rattlesnake population density at the beginning of the year.

(Record your **answer rounded to two decimal places** in the numerical-response section of the answer sheet.)

Answer: _____ snakes/hectare

Numerical Response

8. Calculate the per capita growth rate for the rattlesnake population over the year.

(Record your **answer rounded to two decimal places** in the numerical-response section of the answer sheet.)

Answer: _____

44. Some rattlesnakes were reintroduced into a prairie where secondary succession was evident. Secondary succession differs from primary succession in that secondary succession

A. is a faster process that involves initial soil formation
B. progresses from a pioneer community through one or more stages
C. produces a climax community that contains a greater diversity of organisms
D. occurs in a location previously covered by vegetation and where some soil is present

Use the additional information to answer the next question.

Snakes have an interesting method of smell reception. They sample the air for "smell" molecules with their tongue. In humans, molecules in the air must diffuse into the nasal cavity. Olfactory cells located in this cavity receive the molecules. Olfactory cells in the human have a structure similar to motor neurons.

45. From first to last, the parts of the olfactory cell through which an impulse must travel are

A. synaptic knob, axon, cell body, dendrite
B. cell body, dendrite, axon, synaptic knob
C. dendrite, cell body, axon, synaptic knob
D. axon, cell body, synaptic knob, dendrite

Use the following information to answer the next two questions.

> In populations where it is common for first cousins to marry, some autosomal recessive disorders such as albinism and phenylketonuria are far more likely to occur than elsewhere.

46. If the frequency of a recessive allele changes from 0.0001 to 0.01 after several generations, the most probable reason is that

A. random mating is occurring
B. non-random mating is occurring
C. a high rate of mutation is involved
D. inbreeding causes the population to increase

47. Phenylketonuria is caused by a defect in the synthesis of a specific protein. This type of genetic disorder is **most likely** the result of

A. nondisjunction
B. gene mutation
C. crossing over
D. polyploidy

Use the following information to answer the next question.

To investigate the ecological strategies of dinoflagellates, a type of microscopic algae, researchers set up some aquariums of dinoflagellates. Dinoflagellates were introduced into each aquarium at day 0. After 15 days, the dinoflagellate population bloomed (had a rapid population increase) in each aquarium. Within 48 hours of the appearance of the "blooms," few dinoflagellates remained.

48. The information indicates that the dinoflagellate population studied is

A. *r*-selected with a J-shaped growth population curve
B. K-selected with a J-shaped growth population curve
C. *r*-selected with an S-shaped growth population curve
D. K-selected with an S-shaped growth population curve

The written-response questions begin on the next page.

For Department Use Only

Use the following information to answer the next question.

An association between smoking during pregnancy and adverse pregnancy outcomes has long been known. In contrast to babies born to mothers who do not smoke, babies born to smoking mothers have lower birth weights, stay longer in hospital, and are more likely to be delayed in mental and physical development.

An interesting observation is that fetuses of mothers who smoke have placentas that are thinner and heavier and that have a larger surface area than placentas of fetuses of non-smoking mothers.

A study was conducted of 1 512 pregnant women who were at an average gestational stage of 14 weeks. Information about smoking history, inhalation habits, and exposure to other smokers in the household was gathered.

Birth weights of infants born to these women were measured and adjusted for maternal height, sex of infant, and the length of pregnancy. Average weights of infants were calculated and recorded for five categories of smoking habit of mothers.

Table 1: Smoking Habit Reported at Initial Interviews and Average Birth Weight (total sample size = 1 512)

Smoking habit	Number	Average Birth Weight (Grams)
Non-smokers		
never smoked	400	3 678
stopped before this pregnancy	492	3 671
stopped early in this pregnancy	130	3 671
Total and Overall Average	1 022	3 675
Smokers		
1–14 cigarettes per day	336	3 535
15+ cigarettes per day	154	3 434
Total and Overall Average	490	3 504

—from *Effects of Smoking on the Fetus, Neonate, and Child* and *Scientific American*

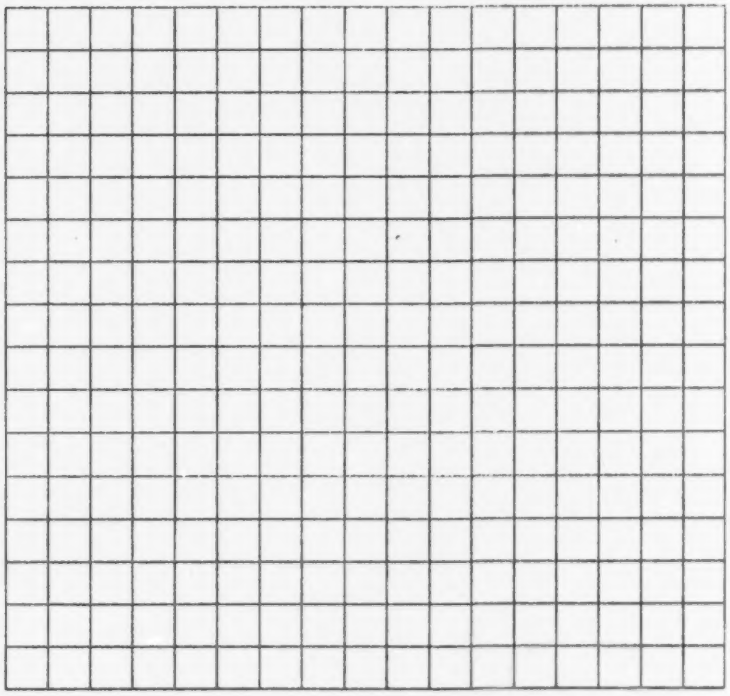
Written Response – 12 marks

(1 mark)

1. a. The birth weights of the infants were adjusted for maternal height, sex of infant, and the length of pregnancy. Using one of these variables, explain the purpose of adjusting the birth weights prior to the analysis of the results.

For Department Use Only

b. Draw a bar graph that **illustrates the differences** in average birth weight of infants born to women in the five categories of smoking habit. **(3 marks)**



c. What conclusion might be drawn from analysis of these data? Identify **four** other factors about the women's histories that should be considered before accepting any conclusions indicated by the data. **(3 marks)**

i. Conclusion:

ii. Factors:

For Department Use Only

Use this additional information to answer the next questions.

> Nicotine and carbon monoxide are two components of cigarette smoke that have been studied extensively.
>
> Nicotine mimics a naturally produced chemical that stimulates neurotransmitter receptor sites on some dendrites. Therefore, nicotine's first effect is to stimulate neurons. Nicotine is not easily broken down, however, and it ultimately blocks the receptor sites, preventing further neural signals. As well, nicotine stimulates the release of epinephrine, which in turn causes the diversion of blood from most of the mother's organs to her skeletal muscles.
>
> Carbon monoxide binds to hemoglobin more easily than oxygen does, thereby reducing the oxygen-carrying ability of the blood. As a result, smokers tend to have lower blood oxygen levels, a condition known as hypoxia.
>
> —from *Effects of Smoking on the Fetus, Neonate, and Child* and *Scientific American*

(2 marks)

d. Explain how exposure to nicotine and carbon monoxide could result in reduced fetal growth and a lower birth weight in infants.

(1 mark)

e. Explain how the observed changes in the placenta of a mother who smokes could be a physiological response to overcome the difficulties created by smoking.

For Department Use Only

f. Realistically, how would you influence women not to smoke during pregnancy?

(2 marks)

Use the following information to answer the next question.

Breast and ovarian cancer have been effectively treated with the use of a natural substance, taxol, obtained from the bark of the Pacific yew tree (*Taxus brevifolia*), an understory tree. A 100-year-old yew tree yields about 3 kg of bark, which provides enough taxol for one 300 mg dose. The bark cannot be harvested without killing the tree. Taxol binds to and interferes with the cell's microtubules (including spindle fibres), which play a crucial role in cell division. As might be expected, cells that divide frequently are most affected by this agent. Cancer cells are well known for "dividing out of control." Additional complications from using taxol include allergic reactions and suppressed immunity, which may or may not be associated with microtubule function.

The stinking yew tree (*Torreya taxifolia*), a relative of the Pacific yew, may also be a source of taxol-related substances. Concern has arisen recently over a serious decrease in numbers of both the stinking yew and Pacific yew trees.

Both the stinking yew and Pacific yew trees grow in association with fungi that have also been discovered to produce taxol. Tapping these fungi for compounds or genes may have enormous medical potential.

The fungus *Pestalotiopsis microspora* lives within the stinking yew tree but normally does not harm the tree. Actually, the fungus is considered to be an endophyte, offering its plant host increased resistance to disease and attack from herbivores. However, in areas where heavy logging has resulted in very dry soil, the fungus causes disease in the stinking yew trees.

—from *Edmonton Journal*
Scientific American
Science News

Written Response – 12 marks

2. Write a unified essay that addresses the following aspects of the use of biological compounds, such as taxol, from the natural environment.

- Using details of cell division, **explain** how taxol could prevent the multiplication of cancer cells. **Describe** how the use of taxol in a human might cause unwanted effects in patients being treated for cancer.
- **Describe** the change in the symbiotic relationship between the fungus *Pestalotiopsis microspora* and the stinking yew tree due to changes in the environment. Use appropriate terminology.
- **Explain** how taxol could be produced using biotechnology and **identify two** benefits of producing taxol this way rather than harvesting yew tree bark. **Describe two** technological problems that might be encountered by scientists trying to produce taxol this way.

.....

.....

.....

40

You have now completed the examination.
If you have time, you may wish to check your answers.

References

MC 2 Black, D. 1995. Scientists probe psychopaths' dark hearts. *The Edmonton Journal*, 12 December.

MC 9 Kaufman, D. G. 1995. *Biosphere 2000: Protecting Our Global Environment.* New York: Harper Collins College Publishers.

MC 24 Glausiusz, J. 1994. Splitting heirs. *Discover* 15 (1): 84–85.

MC 34 Adler, T. 1994. Plants: the new plastic makers. *Science News* 146 (26): 420.

MC 36–38 Downs, R. 1995. A deadly cry. *Discover* 16 (12): 42, 44, 46.

NR 6 Griffiths, A.J.F., J.H. Miller, D.T. Suzuki, R.C. Lewontin, and W.M. Gelbart. 1993. *An Introduction to Genetic Analysis.* New York: W.H. Freeman and Company.

WR 1 Anderson, H.R., J.M. Bland, and J.L. Peacock. 1992. The effects of smoking on fetal growth: evidence for a threshold, the importance of brand of cigarette, and interaction with alcohol and caffeine consumption. In *Effects of Smoking on the Fetus, Neonate, and Child*, ed. D. Poswillo and E. Alberman. Oxford: Oxford University Press.

Doyle, R. 1996. Low-birth-weight babies. *Scientific American* 274 (4): 24–25.

WR 2 Loyie, F. 1997. City doctor will head worldwide cancer project. *The Edmonton Journal*, 20 February.

Nemecek. S. 1996. Rescuing an endangered tree. *Scientific American* 274 (3): 22.

Nicolaou, K.C., R.K. Guy, and P. Potier. 1996. Taxoids: new weapons against cancer. *Scientific American* 274 (6): 94–98.

Travis, J. 1995. Making light work of a cell's skeleton. *Science News* 147 (2): 311.

Illustration Credits

MC 20 Diagram adapted from Cummings, M. R. 1994. *Human Heredity.* San Francisco: West Publishing Co. Reprinted with permission of Nelson Canada.

MC 27 Karyotype taken from Gardner, E. J. 1983. *Human Heredity.* Toronto: John Wiley & Sons, Inc. Reprinted under the Alberta Government Print Licence with CanCopy (Canadian Copyright Licensing Agency).

MC 29 Diagram adapted from Galbraith, D. I. 1993. *Biology Directions.* Toronto: John Wiley & Sons Canada Ltd. Reprinted with permission of ITP Nelson.

Tear-out Page

BIOLOGY DATA

Symbols

Symbol	Description
D_p	population density
N	numbers of individuals in a population
A	area, space, or volume occupied by a population
t	time
Δ	change
r	biotic potential OR maximum per capita population growth rate
K	carrying capacity
$\frac{\Delta N}{\Delta t}$	a change in population size during time interval
$>$	greater than, dominant over
$<$	less than, recessive to

Symbol	Description
♂	male
♀	female
n	chromosome number
B, b	alleles; upper case is dominant, lower case is recessive
I^A, I^B, i	alleles, human blood type (ABO)
P	parent generation
F_1, F_2	first, second filial (generation)
p	frequency of dominant allele
q	frequency of recessive allele

Fold and tear along perforation.

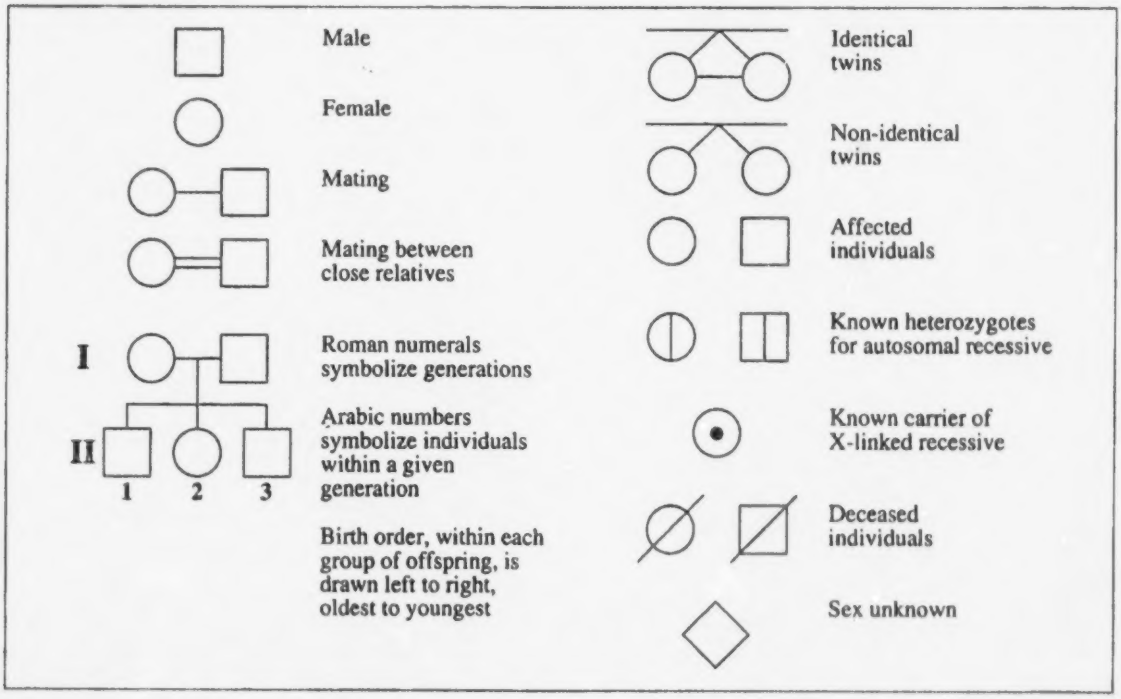
Equations

Subject	Equation
Hardy–Weinberg principle	$p^2 + 2pq + q^2 = 1$
Population density	$D_p = \frac{N}{A}$
Change in population size	$\Delta N = (\text{factors that increase pop.}) - (\text{factors that decrease pop.})$
Per capita growth rate (time will be determined by the question)	$cgr = \frac{\Delta N}{N}$
Growth rate	$\frac{\Delta N}{\Delta t} = rN$ $\quad$ $\frac{\Delta N}{\Delta t} = rN\frac{(K - N)}{K}$

Abbreviations for Some Hormones

Hormone	Abbreviation
Adrenocorticotropin hormone	ACTH
Antidiuretic hormone	ADH
Follicle stimulating hormone	FSH
Human chorionic gonadotropin	HCG
Luteinizing hormone	LH (formerly ICSH in males)
Parathyroid hormone	PTH
Prolactin	PRL
Somatotropin (human growth hormone or growth hormone)	STH (HGH or GH)
Thyroid stimulating hormone	TSH

Pedigree Symbols



Messenger RNA Codons and Their Corresponding Amino Acids

First Base	Second Base				Third Base
	U	C	A	G	
U	UUU phenylalanine	UCU serine	UAU tyrosine	UGU cysteine	U
	UUC phenylalanine	UCC serine	UAC tyrosine	UGC cysteine	C
	UUA leucine	UCA serine	UAA stop **	UGA stop **	A
	UUG leucine	UCG serine	UAG stop **	UGG tryptophan	G
C	CUU leucine	CCU proline	CAU histidine	CGU arginine	U
	CUC leucine	CCC proline	CAC histidine	CGC arginine	C
	CUA leucine	CCA proline	CAA glutamine	CGA arginine	A
	CUG leucine	CCG proline	CAG glutamine	CGG arginine	G
A	AUU isoleucine	ACU threonine	AAU asparagine	AGU serine	U
	AUC isoleucine	ACC threonine	AAC asparagine	AGC serine	C
	AUA isoleucine	ACA threonine	AAA lysine	AGA arginine	A
	AUG methionine	ACG threonine	AAG lysine	AGG arginine	G
G	GUU valine	GCU alanine	GAU aspartate	GGU glycine	U
	GUC valine	GCC alanine	GAC aspartate	GGC glycine	C
	GUA valine	GCA alanine	GAA glutamate	GGA glycine	A
	GUG valine	GCG alanine	GAG glutamate	GGG glycine	G

* Note: AUG is an initiator codon but also codes for the amino acid methionine.

** Note: UAA, UAG, and UGA are terminator codons.

Fold and tear along perforation.

Information About Nitrogen Bases

Nitrogen Base	Classification	Abbreviation
Adenine	Purine	A
Guanine	Purine	G
Cytosine	Pyrimidine	C
Thymine	Pyrimidine	T
Uracil	Pyrimidine	U

Tear-out Page

No marks will be given for work done on this page.

Fold and tear along perforation.

Tear-out Page

No marks will be given for work done on this page.

Fold and tear along perforation.

Tear-out Page

No marks will be given for work done on this page.

Fold and tear along perforation.

Name

Apply Label With Student's Name

Biology 30

Biology 30
June 1997

(Last Name) (Legal First Name) Y M D

Name: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐☐☐☐☐☐☐☐☐☐☐ **Date of Birth:** ☐☐ ☐☐ ☐☐ **Sex:** ☐

Permanent Mailing Address: _____

(Apt./Street/Ave./P.O. Box) (Village/Town/City) (Postal Code)

School Code: ☐☐☐☐ **School:** _____ **Signature:** _____

No Name

Apply Label Without Student's Name

Biology 30

For Department Use Only

M4 ☐ M3 ☐ M2 ☐ M1 ☐